ROYAL ASTRONOMICAL SOCIETY.

VOL. IX. *December* 8, 1848. No. 2.

CAPT. W. H. SMYTH, R.N., Vice-President, in the Chair.

Transit of Mercury, Nov. 8–9, 1848.

By the Rev. W. R. Dawes, at Cranbrook.

"My attention was directed principally to the appearance of the planet at its ingress, and to measurements of its diameter during the transit.

"The ingress was observed with my $8\frac{1}{2}$-foot achromatic, the aperture being limited to 4 inches, the eye-piece magnifying 87 times. So extremely undulating was the edge of the sun in general, that no advantage seemed to arise from an increase of power. Nothing remarkable was noticed till *Mercury* had advanced on the sun's disc to about three-quarters of its own diameter, when the cusps appeared much rounded off, giving a pear-shaped appearance to the planet. The *degree* of this deformity, however, *varied* with the steadiness and definition of the sun's edge, being *least* when the definition was *best*. A few seconds before the complete entrance of the planet, the sun's edge became much more steady, and the cusps sharper, though still occasionally a little broken towards their points by the undulations. At the instant of their junction the definition was pretty good, and they formed the finest conceivable line, *Mercury* appearing at the same time *perfectly round*.

"The impression upon my mind was, that the distortion of the planet arose entirely from the rounding off of the points of the cusps by the tremor and diffusion of the image. I have repeatedly observed precisely the same appearance at the ingress and egress of the shadow of a satellite of *Jupiter*, when the edge of the planet has been rather undulating and diffused.

"For the measurement of the diameter of *Mercury*, I had prepared several different instruments. The filar micrometer was applied to the $8\frac{1}{2}$-foot equatorially mounted achromatic, the clock motion being in use. A 5-foot achromatic by Dollond was furnished with one of his spherical crystal double-image micrometers, and mounted on a very stout floor-stand with an equatorial socket. An excellent Gregorian reflector, of 5 inches aperture and 20 inches focus (the large metal figured by Cuthbert), and furnished with its own divided object-glass heliometer, was also employed. And, lastly, a spherico-prismatic crystal double-image micrometer was

applied to the $8\frac{1}{2}$-foot equatoreal. Measurements were obtained with each of these instruments, but, from the excessive tremor which usually affected the image, the results were not very satisfactory.

With the $8\frac{1}{2}$-foot equatoreal and filar micrometer, power 163, aperture reduced to 2·84 inches,

Polar diameter of *Mercury* = 9″·3694, six observations.

Same instrument and power, aperture 4·02 inches,

Polar diameter = 9″·3890, six observations.

The mean of the two sets = 9″·393.

Same telescope, and spherico-prismatic micrometer, power 184,

Polar diameter = 8″·89, three observations.

With the 5-foot achromatic and the spherical micrometer, power 117,

Polar diameter, by four observations = 9″·02
Equatoreal diameter, by two do. = 9″·36
} diff. = 0″·34

With the heliometer on the 20-inch Gregorian, power 115,

Polar diameter, by four observations = 8″·89
Equatoreal diameter, by ten do. = 9″·20
} diff. = 0″·31

"No difference is recognised in the *Nautical Almanac* between the polar and equatoreal diameters of this planet; yet my observations, both with the 5-foot achromatic and the Gregorian, shew a perceptible difference, and nearly to the same amount. And it was noticed with each of the double-image micrometers that a satisfactory measure of the equatoreal diameter was always perceptibly too large for the polar diameter, the images appearing slightly separated; and that, on the contrary, with a good measure of the polar diameter, the images overlapped when placed in the direction of the equator. The change was repeatedly made from one to the other, and always with the same result. The compression would thus appear to be about $\frac{1}{29}$.

"It will be remarked that no sensible difference was produced in the apparent diameter by varying the aperture from 4·02 inches to 2·84 inches. The same darkening glass was employed with both apertures; and therefore, though the *telescopic* irradiation would be *least* with the *larger* aperture, yet, the image being brighter with that aperture, the *ocular* irradiation would be *greater*. Probably, therefore, the two effects might counteract each other.

"The measurements, though few, were taken with extreme care, each of them having been repeatedly examined under the best views before it was read off."

By Mr. T. Dell, at Dr. Lee's Observatory, Hartwell.

"The time was taken from the transit-clock, the error of which was well known from observations on the 7th and 8th. The first contact was not noted with any degree of certainty: the interior contact was well observed.

Interior contact $14^h\ 18^m\ 55^s{\cdot}3$ Sid. Time, or $23^h\ 3^m\ 57^s$ M. Time at Hartwell.

"My attention was directed by the Rev. Mr. Reade to a phenomenon described by the late Professor Moll (*Mem. Ast. Soc.* vol. vi. p. 116), a recurrence of which we all observed,—Mr. Reade and his assistant, with a Gregorian telescope, at Stone, and again with me here. This is a considerable greyish spot on the disc of *Mercury*, very indefinite, but gradually shading off from the brightest point in the centre to the blackness of the rest of the planet. I have attempted to give some idea of this appearance in the drawing annexed, as seen with a power of 240; with a less power we could not distinguish it."

By the Rev. Mr. Reade, at his Observatory, Stone.

Mr. Reade has sent a drawing of the grey spot observed in *Mercury*, which agrees with Mr. Dell's. The observations consist of a numerous series of angles measured from *Mercury* to spots on the sun, from which M. Fazell has made an elaborate chart of the path of *Mercury* over the sun's disc.

By Mr. Hartnup, at the Observatory, Liverpool.

Equatoreal, $8\frac{1}{2}$-inch achromatic; power, 134.

Internal contact $23^h\ 6^m\ 54^s{\cdot}4$ Greenwich Mean Time.

"The instant is noted at which the sun's light was first seen to surround the planet completely."

NEPTUNE.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1848.	Greenwich M.T. h m s	R.A. h m s	N.P.D. ° ′ ″	Obs^d—Cal^d R.A. s	N.P.D. ″
Oct. 25	10 11 42·9	22 8 52·66	102 8 28·8	−1·62	+ 7·4
27	9 36 22·7	8 48·74	8 48·6	1·72	7·5
29	8 30 54·9	8 45·76	9 6·5	1·37	8·4
Nov. 4	6 22 12·0	8 38·63	9 40·7	1·43	7·8
6	7 58 45·8	8 37·12	9 46·3	1·52	7·2
7	8 50 53·7	8 36·95	9 50·5	1·20	9·4
9	9 39 43·8	8 35·93	9 50·7	1·62	8·0
10	5 43 48·6	5 36·02	9 50·9	1·44	8·3
21	7 58 42·4	8 43·36	9 1·8	1·63	9·5
24	7 5 54·5	22 8 48·24	102 8 34·9	−1·51	+ 11·3

The observations have been corrected for refraction and parallax, and compared with Mr. Adams' Ephemeris.

The star of comparison, for all the observations, is B.A.C. 7722.

The mean place for Jan. 1, 1848, according to the Catalogue, is

R.A. $= 22^h\ 2^m\ 29^s{\cdot}78$ N.P.D. $= 102°\ 18'\ 34''{\cdot}56$

IRIS.

*Approximate Ephemeris.** By Mr. Hind.

Greenwich Mean Noon.

1848.	R.A. h m s	Decl. ° ′ ″	Log. Δ
Nov. 23	10 10 4·3	+6 39 56	0·29729
26	12 48·6	6 14 46	·29080
29	15 21·1	5 50 25	·28420
Dec. 2	17 41·0	5 26 54	·27749
5	19 48·1	5 4 20	·27071
8	21 41·8	4 42 44	·26386
11	23 21·7	4 22 12	·25695
14	24 47·3	4 2 48	·25001
17	25 58·1	3 44 39	·24305
20	26 53·5	3 27 47	·23609
23	27 33·1	3 12 19	·22918
26	27 56·5	2 58 19	·22234
29	28 3·5	2 45 51	·21561
1849.			
Jan. 1	27 53·7	2 35 0	·20902
4	27 27·3	2 25 50	·20262
7	26 44·1	2 18 22	·19645
10	25 44·3	2 12 43	·19056
13	24 27·8	2 8 53	·18499
16	22 55·4	2 6 55	·17980
19	21 7·5	2 6 50	·17503
22	19 4·9	2 8 37	·17074
25	16 48·9	2 12 14	·16698
28	14 19·9	2 17 41	·16381
31	10 11 38·4	+2 24 56	10 0·16129

* From the elements in the *Monthly Notice*, June 1848, without perturbations.

FLORA.

Hamburg. (MM. C. & G. Rümker.)

1848.	Hamburg M.T. h m s	R.A. ° ′ ″	* ″	Dec. ° ′ ″	
Jan. 26	6 18 24·6	63 34 56·2		+18 11 13·7	Equator.
	7 53 30·8	35 30·1	28·2	11 52·6	Mer. Cir.
27	7 50 10·6	63 44 27·1	25·5	18 18 6·0	—
28	7 46 52·4	63 53 55·5	52·6	18 24 15·9	—
29	7 43 37·3	64 4 8·3	10·5	18 30 28·1	—
Feb. 4	7 18 16·0	65 13 15·4		19 7 38·0	Equator.
10	9 46 26·1	66 39 54·7		19 45 20·5	—
11	8 6 33·5	66 54 33·4		19 51 1·8	—
12	7 0 54·3	67 9 38·4		19 56 53·9	Mer. Cir.
15	10 30 48·0	68 2 20·7		20 15 55·5	Equator.
16	6 49 39·9	68 17 4·2	0·7	20 20 54·8	Mer. Cir.
29	8 42 48·0	72 34 37·0		21 34 42·4	Equator.
March 2	7 37 31·0	73 17 21·9		+21 44 7·4	—

* The column below contains the seconds of R.A. observed by Mr. G. Rümker with the transit.

PETERSEN'S SECOND COMET.

Observations.

CAMBRIDGE. Northumberland Equatoreal. (Professor Challis.)

1848.	Greenwich M.T. h m s	R.A. h m s	Log $\frac{p}{P}$	N.P.D. ° ′ ″	Log $\frac{q}{P}$	No. of Comps.	Star.
Nov. 4	11 31 34·9	18 59 33·90	8·851	32 14 36·3	−9·791	2	*a*
	41 7·5	33·63	8·842	43·2	9·804	12	*b*
8	9 22 40·6	19 17 45·37	8·845	35 8 47·3	9·558	6	*c*
9	7 56 18·5	22 8·22	8·768	35 54 5·0	9·281	8	*d*
10	9 45 18·2	27 10·23	8·832	36 47 34·6	9·620	6	*e*
13	6 24 45·4	40 24·47	8·567	39 18 56·5	9·035	1	*f*
	43 52·6	27·59	8·609	19 36·2	9·112	7	*g*
14	7 57 51·3	45 19·94	8·730	40 18 25·3	9·417	6	*h*
15	7 18 8·2	19 49 46·29	8·656	41 14 53·0	9·306	8	*i*
21	8 4 4·9	20 17 1·17	8·670	47 38 0·1	9·556	8	*k*
24	6 50 45·0	20 30 0·08	8·508	51 6 35·9	9·489	6	*l*
Dec. 2	8 59 20·2	21 4 5·39	8·644	61 36 20·3	9·776	3	*m*
4	7 52 38·7	11 57·51	8·563	64 17 33·6	9·741	6	*n*
6	7 19 7·6	21 19 45·79	8·496	67 2 42·8	−9·744	4	*o*

"The corrections to be applied for parallax in time and arc are represented by p and q; P is the equatoreal horizontal parallax, or $\frac{8''\cdot5776}{\Delta}$. The following are the authorities for the places of the stars:"—

a	B.A.C. 6500	*i*	Arg. Z. 134, 35
c	Groombridge 2839	*k*	Groombridge 3157
d	—— 2855	*l*	B.A.C. 7167
e	Arg. Z. 14, 53	*m*	H. C. {41060 / 41062}
f	B.A.C. 6763	*n*	H. C. 41503
h	Arg. Z. 21, 99	*o*	B.A.C. 7474

The assumed apparent place, Nov. 13, of the star *g*, viz. R.A. = $19^h\,39^m\,42^s\cdot28$, N.P.D. = 39° 17′ 10″·5, was determined by one comparison by the equatoreal with B.A.C. 6763; and the mean place of the star *b* was found by meridian observations to be as follows:—

1848, Jan. 0. R.A. = $18^h\,58^m\,41^s\cdot00$; N.P.D. = 32° 12′ 31″·6.

HAMBURG. Equatoreal. (M. C. Rümker.)

1848.	Hamburg M.T. h m s	R.A. h m s	Decl. ° ′ ″
Nov. 7	16 34 44·4	19 14 22·20	+55 25 16·1
8	16 36 43·4	19 3·73	54 38 3·5
14	6 20 3·4	44 52·42	49 47 1·2
15	5 57 6·5	19 49 23·55	48 50 9·3
19	5 45 30·9	20 7 31·71	44 43 40·2
20	5 45 16·3	12 1·89	43 37 44·8
21	5 52 58·7	16 30·96	42 30 5·3
22	7 54 12·9	21 18·58	41 15 15·1
23	7 5 13·8	25 33·40	40 6 59·6
25	7 29 33·3	20 34 21·16	+37 39 43·8

HAVERHILL. (Mr. W. W. Boreham.)

1848.	Greenwich M.T. h m s	R.A. h m s	s	N.P.D. ° ′ ″	″	Star of Comp.
Nov. 19	7 47 40	20 7 59·58	+0·047 × P	45 24 12·0	−0·30 × P	Groom. 3110
24	6 58 18	30 2·81	028	51 5 55·1	32	B.A.C. 7167
28	6 22 58	20 47 3·00	026	56 7 54·6	36	H.C. 40373
Dec. 2	7 15 37	21 3 42·65	033	61 31 50·8	29	— 41162
4	6 36 18	11 43·60	026	64 13 9·6	49	— 41435
5	6 34 45	15 40·30	026	65 36 6·8	51	— 41637
6	6 50 30	19 41·37	028	67 1 0·6	54	B.A.C. 7474
9	7 43 13	31 22·06	034	71 15 32·7	63	— 7520
10	7 46 39	35 11·36	034	72 39 54·8	64	H.C. 42323
15	7 35 15	21 53 15·30	+0·032	79 32 7·6	−0·68	Weisse xxi, 1273

"P is the horizontal parallax of the comet in seconds of space. The observations were made with a bar-micrometer. There is probably an error of 1° in H. C. 42393, the N.P.D. should be 73° instead of 72°."

CAMBRIDGE, U.S.* Equatoreal. (Mr. W. C. Bond.)

1848.	Cambridge M.T. h m s	R.A. h m s	Decl. ° ′ ″	
Nov. 25	6 55 41	20 35 11·2	+37 24 15	with Circles and ε *Cygni*
27	6 58 34	43 45·8	34 52 24·1	Lalande, 40277
29	6 55 53	20 47 57·35	+33 34 54·5	

On Nov. 25, at $6^h\ 56^m\ 41^s$, comet follows a star of 9 mag. in $25^s{\cdot}6$, and is $2'\ 25''{\cdot}1$ to the north of it.

Approx. place of Star, R.A. = $20^h\ 34^m\ 45^s$ Decl. $+37°\ 22'$

"The comet has a nucleus resembling a star of 9·10 magnitude, so well defined that the motion became sensible in the course of one or two minutes. The coma radiates, and is about 5′ in diameter. The tail extends about 20′ opposite the sun. The places are referred to the mean equinox, Jan. 1, 1848."

Elements.

By M. d'Arrest.

Time of Perihelion Passage, 1849, Jan. 19·39335, Berlin M.T.

Long. Perihelion.....	63 16 1·9	Mean Eq^x.
— Node.....	215 13 43·4	1849·0
i	85 2 11·5	
Log. q.....	9·9820574.	Motion direct.

By MM. Petersen and Sonntag.

Time of Perihelion Passage, 1849, Jan. 19·39136, Berlin M.T.

Long. Perihelion.....	63 12 34·7	Mean Eq^x.
— Node.....	215 12 0·0	1849, Jan. 1.
i	85 3 38·9	
Log. q	9·9822562.	Motion direct.

"From the Altona observations of Oct. 26, Nov. 10, and Nov. 25."

* The comet was *discovered* on the evening of Nov. 25 by Mr. G. P. Bond.

By Mr. N. Pogson.

Time of Perihelion Passage, 1849, Jan. 19·372744, Greenwich M.T.

Long. Perihelion.....	63° 11′ 49″·6	Mean Eq^{x}.
— Node.....	215 10 57·7	1849, Jan. 0.
i	85 4 19·54	
Log. q	9·9822469.	Motion direct.

"From Dr. Petersen's observations of Oct. 26, and Mr. Hind's on Nov. 4 and 12. All the small corrections have been taken into account."

Ephemeris. By MM. Petersen and Sonntag, from their Elements.

For Six Hours Berlin Mean Time.

1848.	R.A.	Hourly Variation.	Decl.	Hourly Variation.	Log. Dist^{e} from Earth.	Log. Dist^{e} from Sun.
	° ′ ″	″	° ′ ″	″		
Nov. 30	313 49 0·1	+155·49	+31 18 15·1	−200·18	9·97844	0·10916
Dec. 1	314 50 54·6	154·05	29 57 43·5	202·42	·97652	·10551
2	315 52 14·2	152·58	28 36 21·5	204·37	·97486	·10186
3	316 52 58·3	151·09	27 14 15·7	206·05	·97348	·09821
4	317 53 6·3	149·62	25 51 33·5	207·42	·97238	·09457
5	318 52 38·1	148·06	24 28 21·5	208·52	·97156	·09094
6	319 51 32·9	146·51	23 4 47·3	209·29	·97101	·08731
7	320 49 50·3	144·95	21 40 57·9	209·77	·97074	·08369
8	321 47 30·5	143·39	20 17 1·1	209·92	·97075	·08009
9	322 44 33·1	141·82	18 53 4·0	209·78	·97104	·07650
10	323 40 58·1	140·25	17 29 13·8	209·34	·97161	·07293
11	324 36 45·3	138·68	16 5 37·8	208·61	·97244	·06937
12	325 31 54·8	137·11	14 42 22·9	207·58	·97354	·06583
13	326 26 26·6	135·53	13 19 35·7	206·30	·97490	·06233
14	327 20 20·8	133·97	11 57 22·7	204·75	·97651	·05885
15	328 13 38·0	132·43	10 35 49·6	202·96	·97835	·05540
16	329 6 17·7	130·87	9 15 2·4	200·94	·98042	·05198
17	329 58 20·5	129·35	7 55 6·1	198·72	·98272	·04860
18	330 49 46·6	127·83	6 36 5·2	196·32	·98522	·04526
19	331 40 36·5	126·32	5 18 4·5	193·72	·98792	·04194
20	332 30 50·2	124·82	4 1 7·5	190·99	·99081	·03869
21	333 20 28·1	123·34	2 45 18·0	188·13	·99387	·03550
22	334 9 30·6	121·87	1 30 38·4	185·15	9·99709	·03236
23	334 57 58·3	120·43	+0 17 11·7	182·07	0·00046	·02926
24	335 45 51·3	118·99	−0 55 0·5	178·93	·00397	·02623
25	336 33 9·9	117·56	2 5 56·1	175·71	·00760	·02326
26	337 19 54·9	116·17	3 15 34·4	172·47	·01134	·02038
27	338 6 6·3	114·78	4 23 54·0	169·18	·01518	·01757
28	338 51 44·8	113·43	5 30 54·9	165·89	·01910	·01483
29	339 36 50·8	112·10	6 36 36·6	162·59	·02310	·01218
30	340 21 25·2	110·82	7 40 59·4	159·31	·02716	·00960
31	341 5 27·5	109·55	8 44 3·3	156·02	·03128	·00712
1849. Jan. 1	341 48 58·6	+108·30	−9 45 48·5	−152·77	0·03544	0·00473

Ephemeris for Berlin Mean Noon.

1849.	R.A.	Dec.	Log. Δ	Log. r
	° ′	° ′		
Jan. 0	340 54·5	− 8 28·4	0·03025	0·00774
10	347 49·3	17 58·0	07256	9·98855
20	354 4·2	25 28·9	11169	98228
30	359 55·1	31 41·2	14426	9·99026
Feb. 9	5 41·2	36 53·0	16884	0·01080
19	11 44·2	41 21·5	18584	04022
March 1	18 27·7	45 19·6	19641	07460
11	26 15·7	48 55·1	20216	11086
21	35 34·4	52 9·0	20498	14705
31	46 48·0	54 54·2	20697	18206
April 10	60 7·0	56 54·5	21039	21536
20	75 9·6	−57 48·8	0·21743	0·24676

ENCKE'S COMET.

The following observation was made at Cambridge, U. S., with the circles of the equatoreal, corrected by α^2 *Libræ* :—

Cambridge M.T.

1848 Nov. 25 $18^h\ 5^m\ 20^s$ R.A. $= 14^h\ 52^m\ 59^s{\cdot}4$ N.P.D. 106° 44′ 49″

The observation is corrected for refraction and instrumental error only, and the place is referred to the mean equinox, Jan. 1, 1848.

LIVERPOOL. Equatoreal. (Mr. Hartnup.)

1848.	Greenwich M.T. h m s	R.A. h m s	Corr. Eph. s	N.P.D. ° ′ ″	Corr. Eph. ′ ″	No. of Comps.	
Oct. 10	15 15 59	7 57 13·15	+36·80	36 56 31·0	+2 18·2	9	*a*
18	17 41 46	10 26 57·01	29·98	44 52 2·5	4 38·6	2	*b*
22	17 1 4	11 24 59·43	9·79	53 3 6·7	5 12·5	6	*c*
23	17 33 7	11 37 30·42	8·19	55 21 47·9	4 58·7	5	B.A.C. 3965
25	17 44 23	11 59 27·86	+ 6·39	59 58 11·7	+4 48·1	5	*d*

"For the observations of Encke's comet, four thick wires were placed so as to form a small square in the centre of the field. The hour-circle was set going nearly to sidereal time, the star and comet were brought alternately into the centre of the square, the time noted, and the hour-circle and declination-circle read off. The observations were made under the disadvantage of little previous experience, and the management of the clock was not at that time thoroughly acquired."

"The observations are corrected for parallax and refraction, and compared with the ephemeris published by the Superintendent of the *Nautical Almanac*. The corrections noted must be applied to the ephemeris to produce the observed places."

"The place of B.A.C. 3965, is taken from that catalogue. The mean places of the other stars are :—

	Epoch, Jan. 1, 1848. R.A. h m s	N.P.D. ° ′ ″	*Compared by the Instrument with		
a	7 51 48·08	36 49 32·2	B.A.C. 2967	2	Comparisons.
b	10 23 24·35	45 2 23·9	— 3515	1	—
c	11 24 4·89	60 54 48·6	— 3856,3965		
d	12 2 44·82	60 5 9·7	— 4147	2	—

Description of a Machine for Polishing Specula.
By Mr. Lassell.

"The twelfth volume of the *Memoirs of the Royal Astronomical Society* contains a description of a Newtonian Reflecting Telescope, of 9 inches aperture and 112 inches focus, equatoreally mounted in a revolving dome of 14½ feet diameter.

"Several years' experience in the use of this instrument so well convinced me of its general efficiency, and especially of the convenience and stability of its mounting, that I determined, two or three years ago, to carry out precisely the same principle on a much larger scale.

"With a view of informing myself what degree of perfection is attainable in figuring surfaces of larger mirrors than can be wrought by hand, and also of ascertaining the proportion of aperture to focus which it would be most desirable to adopt, I visited Birr Castle; and, by the kindness of the Earl of Rosse, enjoyed the opportunity of two nights' observations with the 3-foot telescope erected by his lordship.

"I was also favoured with an examination of the whole of the machinery employed in grinding and polishing the great speculum; and I returned so well satisfied with all I had seen, that I very shortly resolved to cast a speculum of 2 feet diameter and 20 feet focus.

"The mode of casting the large speculum which I employed involved the principle, discovered, I believe, and first published, by Lord Rosse, of casting the speculum on what is technically called a *chill*, *i.e.* an iron base, slightly warmed, which causes the speculum to cool upwards in horizontal strata.

"Principally, however, from the difficulty of forming it, I did not employ a base constructed with iron hoops placed edgewise, and turned to the gauge, as Lord Rosse recommends, but, instead of it, a *disk* of cast iron, with its upper surface convex, according to the required radius of curvature, and a rebate formed on the edge of its upper surface, which, receiving a stout iron hoop equal in breadth to the thickness of the speculum, formed an iron mould, and dispensed altogether with the use of sand in the casting. The disk does not require to be *turned*, but if cast from a well-made

* The partial results agree as well as those obtained by the best meridian instruments.

wooden pattern will be sufficiently true; neither do I think turning the hoop essential, though it might be well to turn the inside surface and the edges, if the means of doing so were at hand.

"As it is necessary that the pouring should be pretty quick, in order that there may not be time for the base to solidify any portion of the metal before it is completely covered, I inclined the base a little, pouring on the lowest side, in order that the fluid might rise in one compact wave; and when the disk was nearly covered, it was restored to a truly horizontal position, and the pouring continued, until the mould was sufficiently filled, namely, to the depth of about two inches and three quarters. The hoop was about three inches broad, and having been turned parallel, the mould was in the first instance placed horizontal, by a spirit-level being placed upon its edge. The inclination was produced by the application of a lever, which, when withdrawn, restored the base to its horizontal position, and ensured the equable thickness of the speculum at every part of its circumference."

Mr. Lassell then describes the very ingenious method which he adopted to procure the requisite quantity of metal in the proper state, and his mode of ascertaining that the dose of tin was sufficient. The final proportion which he used is 32 lbs. of copper to 15·09 lbs. of grain tin, and 18 lbs. of white arsenic were stirred up with 438 lbs. of the melted mixed metal.

"The speculum was ground and polished on a machine almost precisely the same as that described by Lord Rosse in his lordship's very interesting paper, published in the second part of the *Phil. Trans.* for 1840.

"I found, however, the grinding process much facilitated by interposing a piece of sheet-lead, about a tenth or twelfth of an inch thick, between the speculum and the iron grinding-tool. This saved the rapid wearing down of the tool and also cut the metal much faster, as the softness of the lead suffered the particles of emery to imbed themselves into it, and thus to form a very keen grinding surface. When the lead, fully charged with the emery, had become smooth, it was exchanged for a fresh piece. When an entire surface had been obtained upon the speculum, the smoothing and perfecting of the surface previous to polishing was produced by the iron tool and the finest washed emery.

"The speculum was polished many times on the same machine, following as nearly as practicable the directions given by Lord Rosse; but, after several months' trial, I did not succeed in obtaining a figure which satisfied me, the best I got being very inferior to the surfaces I had obtained by hand on specula of various sizes, up to nine inches diameter. In despair of success by this process, I ultimately contrived a machine, in which I endeavoured to represent as closely as possible the evolutions of the hand, by which I had been accustomed to produce very satisfactory surfaces on smaller specula."

The machine invented by Mr. Lassell, and constructed by Mr. Nasmyth, for figuring and polishing specula, cannot be made intel-

ligible without figures.* The speculum rests with its face uppermost in a horizontal position, and is carried slowly round by a vertical axis. The polisher rests, with its grinding and polishing surface, upon the speculum, and is moved by a pin which fits loosely into a hole in the centre, at the back of the polisher. The motion of the polisher is that of the driving-pin.

Now this, by a very ingenious and very compact mechanism, receives a compound motion which may be thus imagined. Conceive a circular motion given to a point round the centre of the speculum, and then conceive that the driving-pin has a circular motion round this point. The curve is an *epitrochoid*, and the adjustments of the mechanism enable the workman to give any radius to either circular motion, from 0 up to a certain number of inches. The proportions of these radii, in order to give a parabolic figure, are determined experimentally, in which the relation of aperture to focal length must be considered. The size of the polisher, and even the hardness of the pitch, must also be proportioned to the figure and aperture required. Mr. Lassell finds no difficulty in getting a true parabolic figure when the aperture is one-eighth of the focal length.† The speculum, while grinding and polishing, is supported in the same way as it is in the tube when in use. The principle of this mode of support is mentioned by Lord Rosse, *Philosophical Transactions*, 1840, p. 524.

"The polisher should possess as much stiffness as is compatible with the requisite lightness, and I have found these qualities best combined by making it of white American deal, in two strata, well united by glue and a few screws, with the direction of the grain at right angles, the wood well seasoned, and, if possible, cut out of the same board. The polisher for the 2-foot speculum is made out of $1\frac{1}{8}$ inch board, and has, for symmetry, both the upper and under surfaces convex, to fit the speculum. It is about 2 inches thick at the circumference, $20\frac{1}{2}$ inches diameter, and weighs about 12 lbs. with the pitch surface upon it."

Mr. Lassell then enters very minutely into the mode of coating the polisher with pitch evenly and to a proper thickness, of dividing the surface into equal squares, and the various manipulations which are required to produce a perfect result. The grinding powder is known as *rouge*, and the best quality may be had from Mr. Fox of Saffron Hill.

* A model to half the true size, and the drawing by Mr. Nasmyth, may be seen at the Society's apartments. A model of Lord Rosse's engine, and of the mounting, &c. of the 6-foot reflector at Birr Castle, may also be seen. These were made by Mr. Airy, and presented by him to the Society. Mr. Williams will explain the action and details of all the models to any fellow who wishes for information.

† Mr. Lassell has given so full an account of all his processes that we conceive any person of ordinary intelligence would be able to execute them, but they do not admit of compression, and extend beyond the limits of a *Monthly Notice*. It ought to be mentioned that the Earl of Rosse and Mr. Lassell have at all times freely communicated the steps of progress as soon as these became evident to themselves.

"The whole time occupied in obtaining the requisite lustre varies from about one hour to three, and it ought to be steadily advancing throughout.

"A good idea may be formed of the quality of the operation as it proceeds by watching the motion of the tool. It should be regular and uniform, without any apparent labouring or inequality of speed, and the spontaneous motion which the tool has upon the pin as a centre should be slow and regular. No firm adhesion is ever to be allowed between the tool and speculum: this will take place if a due and regular supply of water be not afforded.

"A second application of powder will rarely be required, and never in any quantity, but many applications of water probably will, and the more rapidly the polish is advancing the more frequently will water be required. It is best applied through a hole in the back of the polisher as near the centre as is convenient, which may perhaps be at about the distance of one-third of the radius. But care should be taken not to give the water in excess. The speculum must never be *dry*, but there must be no superfluous water. It is very conveniently applied with a flat camel's-hair brush, half or three-quarters of an inch broad; but as much as the brush would take up would generally be too much for one application. Towards the end, the water should be added more sparingly, and if needful more frequently, going as near to dryness as may be but *never reaching it*.

"The lustre in this state of the process advances most rapidly. If the process has gone on well the powder will have become almost black at the close. The machine having been stopped, the tool is to be carefully taken off by a sliding motion, and the speculum may then be cleaned with a soft linen cloth or leather; or it may be washed with a soft sponge and water, and then dried, and ultimately rubbed lightly with some very soft wash-leather. If the polishing has apparently wrought smoothly, and the aspect of the tool when taken off, both during the process and at its close, is everywhere of even texture when viewed by an oblique light, the speculum will most likely have a *uniform* curve of some description, whether parabolic or not, for it is a characteristic quality of this machine generally to produce a uniform curve. The quality of the curve is best examined by placing the mirror in its tube, and, by means of diaphragms, exposing separate portions of the mirror of equal area from the centre to the circumference."

"I have been accustomed to produce by hand surfaces of, I believe, great excellence, on various sized specula up to nine inches diameter, of which I may instance my 9-foot equatoreal, which enabled me to discover independently (for I did not previously know of its existence) the sixth star in the trapezium of *Orion*, and with which also the observations of a second division of the ring of *Saturn* were made, as described in the *Astronomical Notices*, vol. vi. p. 11. Such surfaces as these were, however, produced with some degree of anxiety, much manual labour, and perhaps some admixture of accident, especially in the union of a perfectly para-

bolic curve with regularity of surface. The superiority of the machine in these respects is so striking as almost to put comparison out of the question.

"If driven by a steam-engine the manual labour is of course annihilated. The control over the machine, by the setting of the cranks, is such, at least with all foci not less than eight diameters of the speculum, that the curve can be changed almost at pleasure from the spherical side to the hyperbolic side of the parabola, and *vice versâ;* the alterations of the curve being, *cæteris paribus*, almost exactly commensurate with the adjustments of the cranks. In fact, one of the most anxious and laborious operations is, by this machine, converted into an intensely interesting amusement. With moderate care and a little experience a *bad* figure never need to be feared, though it may require two or three successive trials to satisfy the fastidiousness of a cultivated and long-practised eye. The lustre of polish transcends even my best efforts by hand, and is the easiest quality of all to obtain; and however erroneous the figure may be after any unsuccessful effort, the proper curve may be recovered without resorting to the grinder, or indeed materially impairing the polish—at least, I have not found it needful, even when the difference of foci of the central and exterior portions of a mirror has amounted to fifteen hundredths of an inch. In 3 or $3\frac{1}{2}$ hours by the polisher alone, it is possible to annihilate an error even as enormous as this. I have a strong persuasion that this machine might prove eminently serviceable in working the curves of object-glasses of large dimensions, though of this I have no experience."

Mr. Lassell then briefly describes the mounting of the telescope, the form, weight, and dimensions of its component parts, and the covering dome. They are in *principle* almost the same as were used on a smaller scale in his 9-foot Newtonian. There is a very good model of the dome and mounting, presented by Mr. Lassell, at the apartments of the Society.

"To afford some notion of the degree of facility attained in the management of so large a dome and telescope, I may mention, that with an assistant I can, without hurry, place an object, invisible to the naked eye, within the field of the telescope in nine or ten minutes from leaving my house. This includes opening the dome, uncovering the large speculum, attaching the eye-piece, setting from the catalogue for the object, and turning the dome to the required azimuth. Without an assistant, I should require three or four minutes longer, which would be principally occupied in opening the shutters of the dome."

"One of the greatest difficulties I have encountered in supporting the speculum in its various positions equably, is to avoid the effects of the friction of its edge under considerable changes of altitude of the telescope."

"It is obvious, that when the altitude is low, the principal part of the weight of the speculum must be borne upon its edge, and the supporting plates being thus in a great measure relieved from the pressure of the speculum, must, by their elasticity, tend to distort

the metal by pressure at its back; and when the telescope is moved towards the zenith, the plates yield again by the weight of the speculum, while the lower edge, still in hard contact at the points of support, is unduly borne up there, and the equilibrium is destroyed. To remedy this evil I have slung the speculum in a hoop of thin iron, equal in length to half its circumference, the ends of the hoop being attached to swivels fixed in each of the two horizontal brackets, and the lower part of the hoop being thus quite at liberty to rise and fall with the plates.

"This has nearly, if not entirely, removed all perceptible distortion; yet in some positions, and under some circumstances, vestiges of it are to be perceived. I have devised a plan of supporting the metal laterally by an equal tension on the several points of support, and think it may probably be useful; but I have not yet had leisure to carry it into effect.

"Instead of a plane speculum I usually employ a prism, which transmits a pencil two inches in diameter, made for me by Messrs. Merz and Son, of Munich. I am persuaded, from repeated experiments, that the prism has an obvious advantage in light over a speculum, and the material is so fine, and the surfaces so exquisitely wrought, that no perceptible injury of the image exists. The only care necessary in the use of the prism is to preserve it from dew, which it is extremely liable to collect; this I have remedied by having a chamber made in the mounting of the prism, which receives a cube of cast iron enveloped in thick *felt:* this, being moderately warmed and placed in the chamber, effectually prevents the deposition of dew for at least some hours, while the extremely slow radiation through the felt does not produce any sensible disturbance in the formation of the image. The prism is rather small, for though it transmits the entire pencil, there is scarcely any thing to spare, and had it been easy to obtain a sufficiently good one half an inch larger, I should have procured it."

A short Notice of the Equatoreal of the Liverpool Observatory. By Mr. Hartnup.

As the Astronomer Royal will probably give some account of this instrument, which has been constructed on his recommendation and entirely under his superintendence, Mr. Hartnup states, in a few words, that it is of the English construction; that is, the telescope is a transit supported at each end, between two long supports which form the polar axis. The telescope is by Merz of Munich, $8\frac{1}{2}$ inches in aperture, and 12 feet focal length. The circle and declination-circle are each 4 feet in diameter, divided by Mr. Simms upon his "self-acting circular dividing engine."* The

* Described in Vol. xv. of the *Memoirs.* The new altitude and azimuth instrument at Greenwich, which was divided on the same engine, is considered by Mr. Airy to be exceedingly well divided.

hour-circle revolves independently of the instrument, and is carried by clock-work, the moving power of which is a water-mill, regulated by "Siemen's *Chronometric Governor.*" This is so successfully applied, that the rate of the hour-circle is not sensibly altered by clamping the polar axis to it. When the hour-circle is properly adjusted, the instrument reads off right ascensions at once.* The polar axis, which is of wrought iron-plate, is very massive and stiff. The weight of the whole instrument is between 70 and 80 cwt. This keeps all steady, even in very hard gales. The instrument is abundantly supplied with eye-pieces and micrometers. The stiff frame and large circles were evidently designed by Mr. Airy to supply a peculiar power to the instrument. In ordinary mountings, great accuracy is not to be expected when the star of reference is more than a few minutes distant from the object compared. The screw of the micrometer is not to be relied upon for larger spaces, and the circles, though sufficient for finding and identifying, are seldom intended for accurate measures. Stars of comparison can, indeed, generally be found which are contained in some of the special and extended catalogues, but such stars can only be considered to be roughly known, and in many cases fail altogether. The Liverpool equatoreal is intended to measure *by its circles* intervals of a few degrees, with as much accuracy as the average stars of our extensive catalogues possess, and thus to give excellent places by reference to well-known stars.

Mr. Hartnup has made some observations to test the powers of his equatoreal in this respect. The observations of γ, α, β *Aquilæ*, of α and β *Lyræ*, of *Castor* and *Pollux*,† shew satisfactorily, that within such limits as these the instrument will measure differences of right ascension and north polar distance almost, if not altogether, as well as can be expected from the best meridian instruments.

Mr. Hartnup further remarks, that the instrument keeps its adjustments steadily, which seems to shew that it is not only firm in itself, but, also, that it rests on a sound foundation. The observations by Mr. Hartnup, of standard stars in all parts of the heavens, are not sufficiently numerous to yield a safe estimate of the probable error of a single independent determination, but it is evidently very small, even for stars at 6^h from the meridian.

Mr. Bishop's Ecliptic Charts, from Observations at the South Villa Observatory.

Our treasurer, Mr. Bishop, has lately published the first hour of an ecliptic chart for the epoch 1825. This contains all the stars to the 10 mag. inclusive in a zone of 6° of latitude, 3° on each side

* This contrivance is peculiar to the equatoreals of Cambridge and Liverpool, and in some researches is of great convenience.

† These observations are given in detail in the accompanying memoir.

the ecliptic. The scale is 1·2 inches to 1°, which gives a clear and open map. The execution is very good.

In the notice which accompanies the chart Mr. Bishop says, "It is the first of a series of twenty-four charts, which I hope to publish. . . . The discovery of planets is materially facilitated by mapping down the stars within a few degrees on each side the ecliptic; and it is for this purpose I have undertaken the present series of charts. . . . The stars included in Weisse's Catalogue from Bessel's Zones were first laid down for 1825 as points of reference. All other stars, to the tenth magnitude inclusive, were then entered by estimation of their positions with respect to the neighbouring members of Weisse's Catalogue. . . . The charts for the hours of right ascension in which the ecliptic falls beyond the declination limits of the Berlin maps (−15°) are in a state of forwardness, and will be published as soon as they are completed. They are regularly compared in their present state with the heavens, so that the search for planets and the formation of the charts are going on at the same time. . . . I take this opportunity of expressing my warmest thanks to Mr. J. R. Hind, for the great care and indefatigable zeal he has displayed in the formation of this chart, which, to my knowledge, he has examined with the heavens from fifty to sixty times; but the success of his research, as shewn by the discovery of two planets, speaks for itself, and will, I am sure, dispose astronomers to receive these charts with confidence."

The charts are published by Messrs. Taylor, Walton, and Maberly, Gower-street, London.

Extract of a Letter from Lieut. Gilliss, U.S.N.*

"The computations for the longitude of Washington, from corresponding moon-culminations observed by me between 1838–1842, are nearly completed. The results for 1839 and 1840 give the following corrections of the (hitherto received) longitude :—

1st Limb	− 5ˢ·39	by 182	comparisons	
2d Limb	− 4·41	74	—	
Mean	− 4·84	256	—	according to weight.

The European observatories with which the comparisons are made, are Edinburgh, Oxford, Greenwich, Cambridge, and Hamburg: the individual results very accordant; those from Cambridge strikingly so. Comparisons have also been made with the observations of Copenhagen, Kremsmunster, Cracow, and Wilna, which seem to shew considerable errors in the longitudes assigned to those observatories."

* Lieut. Gilliss became very favourably known to many members of this Society on his visit to England a few years ago. The observations made at Washington were published in 1846 by the order of the Senate, and have been very freely distributed here and on the continent. They are a proof of what may be done with moderate means by a skilful and conscientious observer.

London :—Printed by George Barclay, Castle Street, Leicester Square.

Extracts of a Letter from Dr. Forster, of Bruges.

"I have long wished to call the attention of the Society to a very curious fact in the chronology of lunations, if I may so express myself; but I have always been deterred by an apprehension that it had so much the air of superstition about it, that it might, in many minds, rather excite ridicule than interest. Still, however, facts are not to be despised, and I have resolved to point out to you, that whenever the new moon has fallen on a Saturday, the following twenty days have been wet and windy. This must depend on some cycle of lunations whose influence on our atmosphere has hitherto escaped the notice of meteorologists. I first perceived the coincidence to which I allude in Sussex, in the years 1817–27, and at that time thought it accidental, but on accurately examining a journal of the weather kept in my family by my grandfather, my father, and myself, in succession, I find that in every twenty Saturdays' new moons, nineteen have been actually stormy and the rest doubtful; and this has been the case ever since our journal began, A.D. 1767, up to the present time. I find, too, that the greatest storms of wind on record have been during the month following a *Saturday's moon*. It would be interesting to know whether this observation applies to other latitudes, and with a view of ascertaining the same, it is that I have thought it worth while to call the attention of the Society to the subject. For, during the last twenty-nine years, I have been enabled, in some measure, to predict the sort of weather that we should have for a long period, by examining the calculated times of new moon. It may here be observed, that stormy months, thus indicated, are characterised by the prevalence of S.W. and W. winds.

"*Periodical and other Meteors.*—On the night of the 13th of November last, a clear interval occurring between 10^h and $13^h\ 50^m$, I observed the sky to be marked by numerous small meteors shooting, in general, towards some point in the heavens, as nearly as I could judge N.N.W.; but unfortunately I was not in a position to make any accurate observations. Several hundreds of meteors must have occurred during the three hours and a half to which I allude; the clouds then closing the sky, I gave up observation. The meteors were small and very white, and generally left long trains behind them: one meteor had a contrary direction, it was larger than the rest, and moved slowly across the zenith towards the S.E. I am most decidedly of opinion that this phenomenon is altogether atmospherical and connected with electrical changes; nor does their motion, in the apparent direction of the magnetic poles, at all militate against this hypothesis of their electrical origin. A few occurred last 10th August, during a disturbed state of the atmospheric electricity; and I saw three on the 20th December."

On the Variability of λ Tauri. By Mr. Baxendell.

"On the night of the 6th instant I observed that the star λ *Tauri* was decidedly less bright than usual, being barely equal

to ν, a little less bright than γ, and decidedly below o and ξ, whilst on the previous night I had noted it down as being a little brighter than o and ξ, and decidedly above γ and ν, and in all my former observations I had invariably placed it above γ. On the following night (the 7th) it had nearly recovered its usual lustre, being decidedly brighter than ν, above γ, and equal to o and ξ. A short time previous to the 6th instant I had remarked that my former observations of the stars o, ξ, and λ *Tauri* exhibited discordances which rendered it impossible to fix, with certainty, the order in which these stars ought to be placed. After the observations on the nights of the 6th and 7th instant, there could be no doubt that these discordances were mainly, if not wholly, due to the variability of λ; and on carefully re-examining all my observations of this star, I was led to infer that its changes were accomplished in a period of only about four days. I therefore continued to watch it very closely, and on the night of the 10th instant had the satisfaction of again observing it reduced to an equality with ν. As, however, the presence of the moon on that night might be supposed to have interfered with the estimations, I have continued my observations regularly since; and having observed λ decidedly reduced in brightness on the nights of the 14th, 18th, and 22d inst., I can no longer have any hesitation in concluding that this star belongs to the list of variable stars of short period, being, in fact, the next in order after β *Persei*, the period of which is the shortest yet known."

Dr. Gerling, of Marburg, published (*Astron. Nach.* 502) an account of a method for determining the parallax of the sun by observations on *Venus* and *Mars* when nearest the earth, and requested the co-operation of American astronomers. Lieut. Gilliss, having satisfied himself that the method was feasible, volunteered his services to the American government to carry Dr. Gerling's proposal into effect, and the expedition is now preparing.

Lieut. Gilliss is to place himself in the most suitable station he can find on the coast of Chili, where he is to make meridian and extra-meridian observations of both planets, at the proper times, in correspondence with other observers at home. He also proposes to observe an extensive catalogue of southern stars, and make various astronomical and magnetical observations. His instruments are a 3-foot meridian circle, with a telescope of 52 lines aperture, made by Pistor and Martius, of Berlin, under Professor Encke's direction; a 5-foot equatoreal, with clock motion, by Fraunhofer; clock, chronometers, &c. Lieut. Gilliss expects to leave home in about six months, and to be absent two or three years.

At the close of the evening the Chairman informed the meeting that the Astronomer Royal had presented the models of Lord Rosse's telescope and polishing machine to the Society. Thanks were returned to the Astronomer Royal for his present. They are now in the meeting-room for examination.